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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
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Nonwoven layer for a filter

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NONWOVEN LAYER FOR A FILTER

Description

The invention is directed to a nonwoven layer for a filter, in particular, for a vacuum cleaner bag.

Nowadays, many vacuum cleaner bags comprise composites of nonwoven materials instead of conventional filter paper, these composite materials showing a high filtration efficiency and capacity.

EP 0 960 645 discloses such a prior art vacuum cleaner bag. This prior art construction is made of three layers, namely, in the direction of the air flow, a bulky meltblown, a meltblown fleece and a spunbond or spunlace layer. The upstream bulky meltblown layer which will be located at the inner side of the bag serves to remove larger dust particles and to hold the dust in its structure.

The prior art filter structures have a high filtration efficiency. However it turned out in practice that elongated particles or objects with small diameters such as hairs (having a diameter of about 70.2 ± 12.3 µm) tend to penetrate the filter. This penetration mainly occurs in the region where the stream of air of the vacuum cleaner meets the wall of the filter bag. The elongated objects act like spears and pierce the filter structure. Although these elongated objects usually do not exit the filter bag, many of them stick out of the outermost layer of the bag. Therefore, these objects are visible from the outside, which is aesthetically disturbing.

In view of this, it is the problem underlying the invention to provide a material that is suitable for use in a filter and has a better retention regarding elongated particles and objects.

This problem is solved by a filter comprising the features of claim 1. Accordingly, the invention provides a nonwoven layer for a filter, in particular, for a vacuum cleaner bag, wherein at least one region of the nonwoven layer, the region having

a predetermined thickness and a predetermined area, has an average pore size smaller than 50 μm and comprises fibers being bonded together such that a movement of the fibers relative to each other in a direction parallel to the surface of the layer is inhibited.

Surprisingly, it was found that a nonwoven layer having these features reduces the above-mentioned problem of penetration while maintaining a desired air permeability to a high degree. The at least one region can be chosen so as to correspond only to the area where a stream of air meets the nonwoven layer. Alternatively, the at least one region can be the whole area of the nonwoven layer. The thickness of the region may range from a thickness of the order of magnitude of one fiber diameter up to the total thickness of the nonwoven layer.

Such a bonding of the fibers has the effect that an elongated object striking the nonwoven layer is inhibited or even prevented of displacing the fibers in a direction parallel to the surface of the layer. This would happen with loose fibers that are not bonded in such a way. Therefore, the penetration of the elongated objects is reduced or prevented.

However, it is not necessary that two fibers are bonded to one another at each point where they are touching or crossing each other. In some cases it is also sufficient if the fibers are bonded only at some crossing points.

According to a preferred embodiment, the nonwoven layer can be an airlaid and/or carded nonwoven layer, a spunbond or spunlace nonwoven layer or a meltblown nonwoven layer.

Advantageously, any of the above-described nonwoven layers can have a basis weight between 10 and 100 g/m^2 and the spunbond or spunlace fibers can have an average fineness of 0.6 to 12 denier, the meltblown fibers can have an average diameter of 1 μm to 15 μm and the carded fibers can have an average fineness of 1 – 16.7 denier. These diameters ensure excellent filtration and air permeability properties.

According to a preferred embodiment of the above-described nonwoven layers, the at least one region can comprise an adhesive. This adhesive enables the bonding of the fibers in a very efficient manner.

According to a preferred embodiment, the adhesive can be a hot melt, a cold glue, a dry bond adhesive and/or a thermoplastic polymer, preferably a pulverized polymer. In the case of a hotmelt, preferably one additional layer covers the tacky hotmelt. An example of a thermo-plastic pulverized polymer is a pulverized polyolefin.

In an advantageous embodiment, the amount of hotmelt can be between 1 and 10 g/m^2. In a more preferred embodiment, the basis weight of the hotmelt is approximately 3 - 5 g/m^2. Such a basis weight guarantees, on the one hand, a high penetration reduction and, on the other hand, still sufficient air permeability.

According to an alternative advantageous embodiment, the at least one region can be a hot calendered region.

The above-described nonwoven layers can be implemented in a filter composite in form of an additional layer. Alternatively, layers already present in a filter, such as a filter layer (for example meltblown layer), a support layer (for example a spunbond layer) or the like can be provided with fibers bonded together such that the movement of the fibers is inhibited.

The invention also provides a composite layer for a filter, in particular, for a vacuum cleaner bag comprising:

a first nonwoven layer according to one of the previously described nonwoven layers, and

a second nonwoven layer on top of the first nonwoven layer,

wherein an adhesive is located at an interface between the first and second nonwoven layer such that fibers of the first and/or the second nonwoven layer are bonded together and a movement of the fibers in the first and/or second non-

woven layer relative to each other in a direction parallel to the surface of the layer is inhibited.

Thus, the fibers in such a composite layer are bonded together within one layer, within each one of the layers and/or between the two layers.

According to a preferred embodiment, the first or the second nonwoven layer is a spunbond nonwoven layer, the other nonwoven layer is a meltblown nonwoven layer, and the adhesive is a hotmelt. Such a structure guarantees excellent filtration properties since the meltblown layer may act as filter and the spunbond layer may act as a support layer and the combination of both layers avoids penetrating of elongated objects through the structure.

The invention further provides a method for producing a nonwoven layer as described above comprising the step of:

treating at least on region of the nonwoven layer, the region having a predetermined thickness and a predetermined area, such that the nonwoven layer has an average pore size smaller than 50 µm and such that the fibers are bonded together and a movement of the fibers relative to each other in a direction parallel to the surface of the layer is inhibited.

According to the preferred embodiment, the treating step comprises the steps of:

spraying of hotmelt, cold glue, dry bond adhesive and/or thermoplastic polymer, preferably pulverized polymer, and

applying pressure to obtain a bonding of the fibers.

According to an alternative advantageous method, the treating step comprises the step of hot calendering.

The invention also provides a method for producing a composite layer as described above comprising the steps of:

providing a first nonwoven layer,

applying an adhesive to the first nonwoven layer, and

providing a second nonwoven layer,

wherein the adhesive is located at an interface between the first and second nonwoven layer such that fibers of the first and/or the second nonwoven layer are bonded together and a movement of the fibers in the first and/or second nonwoven layer relative to each other in a direction parallel to the surface of the layer is inhibited.

According to a preferred embodiment, this method further comprises the step of applying pressure to obtain a bonding of the fibers. In this way, an improved bonding of the fibers can be obtained.

Further features and advantages of the invention are described with reference to the drawings.

Figure 1 shows a sectional view of a first example of a composite layer in accordance with the invention.

Figure 2 shows a sectional view of a second example of a composite layer in accordance with the invention.

Figure 1 shows a section of an example of a three-layer composite. The direction of the airflow is indicated by an arrow. The first upstream layer is a bulky meltblown or air laid layer 1 by a meltblown fleece 2. Downstream, the meltblown fleece 2, a spun bond layer 3 is located. At the interface between meltblown fleece 2 and spunbond layer 3, hotmelt 4 is located. Due to the hotmelt, the fibers in the spunbond layer 3 and the meltblown layer 2 are bonded together and, thus, kept in a relatively fixed position. Incoming elongated objects such as hairs may penetrate the bulky meltblown 1 and meltblown 2. At the interface between melt-

blown 2 and spunbond 3, the fibers within each layer and between the layers are bonded together due to the hotmelt. Due to this bonding together, the pore size in the region of the bonded fibers is less than 50 µm, preferably 15 µm. Therefore, a relative displacement of the fibers at the interface is inhibited or even prevented; a further penetration of the hairs is avoided. In this example, the treated region extends over the whole area of the nonwoven layer. The thickness of the region is very small; only fibers situated at the interface are bonded together. Thus, the thickness is of the order of magnitude of some fiber diameters. Of course, the thickness of the treated region can be increased if desired and necessary.

An alternative example is shown in Figure 2. The structure of the composite is the same as in the first example. However, no hotmelt is present. Instead of the hotmelt, the spunbond 3 was hot calendered. This calendering results in a modified region 5 where the fibers are bonded together. According to a preferred embodiment, the spunbond 3 is a polypropylene having a basis weight of approximately 65 g/m^2 and an average fineness of about 2.5 denier or a basis weight of approximately 25 g/m^2 and an average fineness of about 0.9 denier. Then, preferred process parameters for the calender step are a pressure of 5 bar, a temperature of 160° C and a speed of 10 – 20 m/min. In this example, only a selected area of the spunbond is treated. The thickness of the region, however, corresponds to the whole thickness of the spunbond layer 3. Therefore, in a final vacuum cleaner bag, this region preferably is to be placed where the incoming airflow strikes the bag.

It is to be understood that a nonwoven layer according to the invention can be used in other composite structures as well.

Claims

1. Nonwoven layer for a filter, in particular, for a vacuum cleaner bag, **characterized in that** at least one region of the nonwoven layer, the region having a predetermined thickness and a predetermined area, has an average pore size smaller than 50 µm and comprises fibers being bonded together such that a movement of the fibers relative to each other in a direction parallel to the surface of the layer is inhibited.

2. Nonwoven layer according to claim 1 wherein the nonwoven layer is an airlaid and/or carded nonwoven layer, a spunbond or spunlace nonwoven layer, or a meltblown nonwoven layer.

3. Nonwoven layer according to claim 2 having a basis weight between 10 and 100 g/m^2 and wherein the spunbond fibers have an average fineness of 0.6 – 12 denier, the meltblown fibers have an average diameter of 1µm – 15µm, and the carded fibers have an average fineness of 1 – 16.7 denier.

4. Nonwoven layer according to one of the preceding claims wherein the at least one region comprises an adhesive.

5. Nonwoven layer according to claim 4 wherein the adhesive is a hotmelt, a cold glue, a dry-bond adhesive, and/or a thermoplastic polymer, preferably a pulverized polymer.

6. Nonwoven layer according to claim 5 wherein the amount of hotmelt is between 1 and 10 g/m^2.

7. Nonwoven according to one of the claims 1 – 3 wherein the at least one region is a hot calendered region.

8. Composite layer for a filter, in particular, for a vacuum cleaner bag, comprising:

   a first nonwoven layer according to one of the claims 1 – 6, and

   a second nonwoven layer on top of the first nonwoven layer,

wherein an adhesive is located at an interface between the first and second nonwoven layer such that fibers of the first and/or the second nonwoven layer are bonded together and a movement of the fibers in the first and/or second nonwoven layer relative to each other in a direction parallel to the surface of the layer is inhibited.

9. Composite layer according to claim 8 wherein the first or second nonwoven layer is a spunbond nonwoven layer, the other nonwoven layer is a meltblown nonwoven layer, and the adhesive is a hotmelt.

10. Method for producing a nonwoven layer according to one of the claims 1 – 7 comprising the step of:

    treating at least one region of the nonwoven layer, the region having a predetermined thickness and a predetermined area, such that the nonwoven layer has an average pore size smaller than 50 μm and such that the fibers are bonded together and a movement of the fibers relative to each other in a direction parallel to the surface of the layer is inhibited.

11. Method according to claim 10 wherein the treating step comprises the steps of:

    spraying of hotmelt, cold glue, dry-bond adhesive, and/or thermoplastic polymer, preferably pulverized polymer, and

    applying pressure to obtain a bonding of the fibers.

12. Method according to claim 10 wherein the treating step comprises the step of hot calendering.

13. Method for producing a composite layer according to claim 8 or 9 comprising the steps of:

    providing a first nonwoven layer,

    applying an adhesive to the first nonwoven layer, and

    providing a second nonwoven layer,

wherein the adhesive is located at an interface between the first and second nonwoven layer such that fibers of the first and/or the second nonwoven layer are bonded together and a movement of the fibers in the first and/or second nonwoven layer relative to each other in a direction parallel to the surface of the layer is inhibited.

14. Method according to claim 13 further comprising the step of applying pressure to obtain a bonding of the fibers.

Abstract

The invention is directed to a nonwoven layer for a filter, in particular, for a vacuum cleaner bag, wherein at least one region of the nonwoven layer, the region having a predetermined thickness and a predetermined area, has an average pore size smaller than 50 μm and comprises fibers being bonded together such that a movement of the fibers relative to each other in a direction parallel to the surface of the layer is inhibited. The invention is further directed to a method for producing such a nonwoven layer.

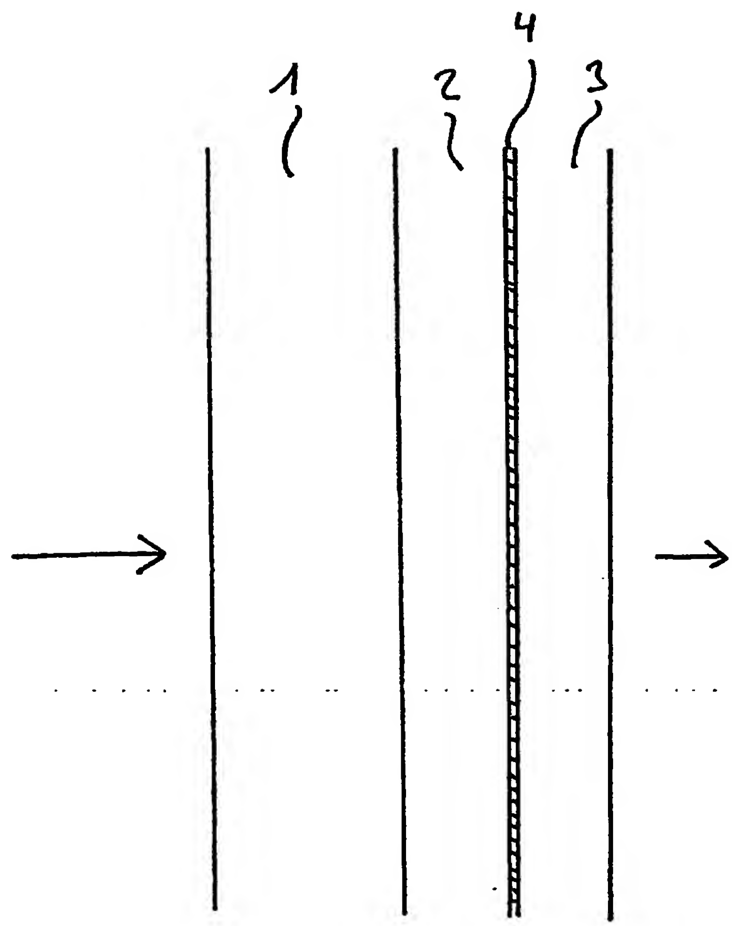

Fig. 1

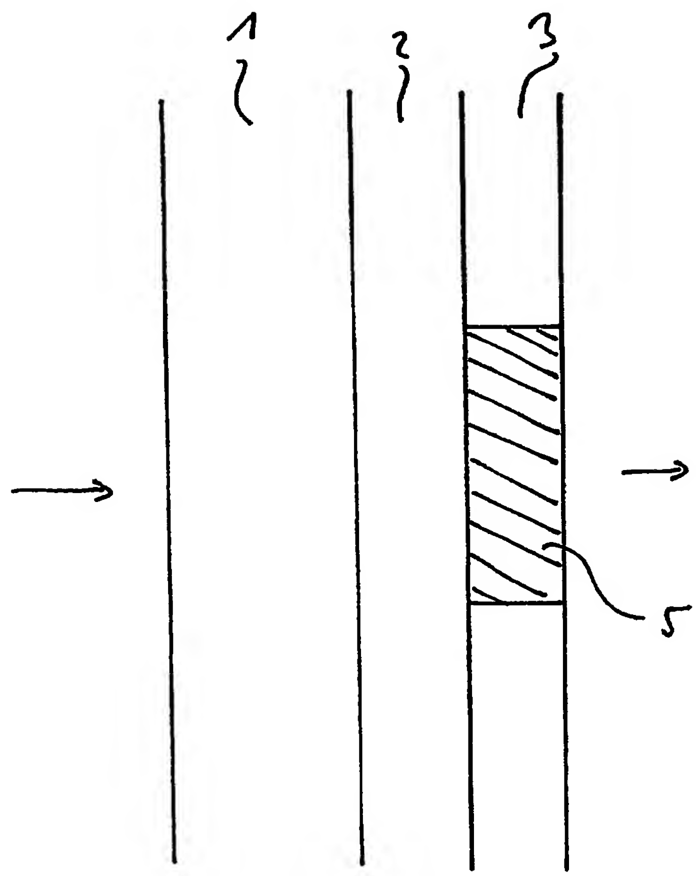

Fig. 2